1000-meter Universal Transverse Mercator grid ticks.

zone 12, shown in blue

grained, well-sorted sandstone. Present as large blocks within Tertiary lava flows and intrusive rocks PALEOZOIC ROCKS

Ac Calcareous sedimentary rocks, marble, and derivative skarn deposits Quartzite interbedded with carbonate rock (**P.c**)

-? CONTACT—Dashed where approximately located, queried where gradational - GRADATIONAL CONTACT BETWEEN INTRUSIVE AND EXTRUSIVE PARTS OF SAME ROCK UNIT—Approximately located. Mapped only between units

> ball on downthrown side. Inclination and direction of dip shown where known - LINEATION—Faint linear alinement of vegetation or strong topographic alinement seen on aerial photographs, possibly related to faults or to fault-controlled surface drainage

ANTIFORM AXIS—Reflects axis of broad, intensely faulted antiform of Last Chance Bench (Machette, 1982a) developed primarily in basin-center lacustrine facies of upper sequence of basin fill (QTsI), in gravel of Last Chance Bench (Qglc), and in old and middle terrace alluvium (Qto and Qtm). Axis of antiform, shown in segments, strikes north from Beaver River, 1.5 km west of Greenville, to The Hogsback and is largely coincident with southward projection of Maple Flats horst. Growth of antiform has been concurrent with deposition during Pliocene (?) and Pleistocene time.

grained basin-fill deposits (QTsI and QTsp). Hachures on downdropped side SURFACE TRACE OF PALEOTOPOGRAPHIC WALL OF MOUNT BELKNAP CALDERA—Dashed where approximately located or concealed, mainly by landslide deposits (QIs). Hachures toward caldera DIKE—Showing inclination and direction of dip. Mapped in secs. 19, 20, 29

and 30, T. 27 S., R. 6 W.

SELECTED REFERENCES flows making up much of lower part of exposed fill within Mount Belknap

hypidiomorphic granular aggregate of orthoclase, plagioclase, quartz, biotite, and prominent accessory sphene. Quartz constitutes about 25 percent of rock. Cenozoic mafic volcanism, southwestern Utah and adjoining areas: American Journal of Field evidence indicates that granite cuts syenite (Tis). May be same age as Science, v. 280, no. 12, p. 1035-1050. Callaghan, Eugene, 1939, Volcanic sequence in the Marysvale region in southwest-central Utah: POTASSIUM-RICH MAFIC LAVA FLOWS (MIOCENE)—Dark-gray to black,

Cunningham, C. G., and Steven, T. A., 1979, Mount Belknap and Red Hills calderas and 1468, 34 p. light- to dark-gray rhyodacite porphyry lava flows and flow breccia. Average Survey Miscellaneous Field Studies Map MF-1191, scale 1:24,000. mineral composition is 9 percent sanidine, 7 percent plagioclase, 2 percent

amphibole, 2 percent clinopyroxene, 1 percent magnetite, 1 percent biotite, and traces of quartz and accessory minerals in glassy groundmass (77 percent) containing numerous microlites and devitrification products (Sigmund, 1979). Both planar and contorted flow layering common. Potassium-argon age 21.7±0.4 m.y. (Fleck and others, 1975). Maximum thickness about 300 Ttl TUFF OF LION FLAT (MIOCENE)—Light-gray to grayish-pink, poorly welded

fragments, volcanic dust, and about 5-15 percent phenocrysts of plagioclase, quartz, sanidine, biotite, and amphibole. Locally includes as much as 10 perby wind and(or) water. Named for outcrops near Lion Flat, in southeastern part of quadrangle. Thickness about 100 m Td MOUNT DUTTON FORMATION (MIOCENE AND OLIGOCENE)—Gray to darkgray lava flows, flow breccia, and volcanic-mudflow breccia of generally

phenocrysts of plagioclase, amphibole, and pyroxene. Most of formation is vent facies according to terminology of Parsons (1965, 1969) and of Smedes and Prostka (1973). Age ranges from 26 m.y. (potassium-argon determination of Fleck and others, 1975) to about 21 m.y. (based on stratigraphic position relative to other isotopically dated units). Thickness in hundreds of meters Ttbr TUFF OF BEAVER RIVER (MIOCENE)—Brownish- to reddish-gray, densely welded, crystal-poor ash-flow tuff, consisting of less than 10 percent phenocrysts of plagioclase, pyroxene, and minor biotite and iron-titanium,

Dutton Formation (Td). Named for outcrops along Beaver River in southeastern part of quadrangle. Thickness about 8 m FF OF BLACK MOUNTAIN (MIOCENE)—Reddish-brown to brownish-gray, densely welded ash-flow tuff containing grayish-black basal vitrophyre. Consists of 20-30 percent phenocrysts of plagioclase, pyroxene, minor sanidine and iron-titanium oxides, and traces of biotite in a devitrified matrix of shards,

of quadrangle. Thickness about 10 m SIRIS TUFF (MIOCENE)—Gray, densely welded, crystal-rich, rhyodacitic ashflow tuff containing prominent phenocrysts of plagioclase, pyroxene, and minor

sanidine, biotite and iron-titanium oxides. Potassium-argon age about 22 m.y. (Fleck and others, 1975). Exposed only in northeastern part of quadrangle BULLION CANYON VOLCANICS (MIOCENE AND OLIGOCENE)—Originally defined by Callaghan (1939). Consists largely of vent-facies rocks interlayered with several named ash-flow tuffs Quartz monzonite and latite (Miocene and Oligocene)—Occurs mostly in two

blende, biotite and accessory apatite, zircon, and iron-titanium oxides

Upper member (Miocene) — Dark-gray to brown rhyodacite to andesite lava

crystal-rich quartz latite ash-flow tuff containing phenocrysts of plagioclase hornblende, iron-titanium oxides, and minor quartz, biotite, and apatite. Source is Big John caldera northeast of quadrangle (Steven, Cunningham. and Anderson, 1979). Potassium-argon age 21.8±1.0 m.y. (Steven, Cunningham, and others, 1979). Mapped only in one area about 2 km west of Ponderosa Park, southeast corner of quadrangle. Thickness about 15 m Three Creeks Tuff Member (Oligocene)—Dark-gray to reddish-brown, densely welded, crystal-rich quartz latite ash-flow tuff containing phenocrysts of plagioclase (35 percent), homblende (9 percent), biotite (3 percent), and quartz (2 percent). Accessory minerals include iron-titanium oxide minerals and sanidine. Present only in northeast corner of quadrangle, this is basal ashflow tuff member of Bullion Canyon Volcanics (Tb). Potassium-argon age

27 m.y. (Steven, Cunningham, and others, 1979) SYENITE (MIOCENE?)—Light- to dark-gray, medium- to coarse-grained, por-

RHYOLITE AND RHYOLITE TUFF OF GILLIES HILL (UPPER MIOCENE) Rhyolite—White to light-gray, thick, local lava flows and volcanic domes of flowlayered rhyolite. Texture varies from nearly aphanitic to porphyritic. Rock contains abundant phenocrysts of sanidine, plagioclase, quartz, biotite, and hornblende; quartz phenocrysts commonly partly resorbed. Matrix finely granular and varies from dense to highly vesicular. Potassium-argon age about 9 m.y. (Evans and Steven, 1982)

FELSITE (UPPER? MIOCENE)—Pink to light-gray, locally porphyritic rock con-

rhyolite of Gillies Hill (Trg)

MOUNT BELKNAP VOLCANICS (MIOCENE) Dikes and flows—Several light-gray to light-brown, small, aphanitic dikes and lava flows west of paleotopographic wall of Mount Belknap caldera, north of Indian Creek. Fission-track age about 16 m.y. (Cunningham and others,

Upper tuff member—Light- to dark-gray, crystal-poor, rhyolitic, partially welded, intracaldera-facies ash-flow tuff. Youngest tuff within Mount Belknap caldera; lithologically similar to Joe Lott Tuff Member (Tmj)

horizon and (or) well-developed stage III to weak stage IV K horizon (see Gile and others, 1965, for definition of K horizon; Machette, 1982a). Widespread pediment was cut across existing intrabasinal structures developed in basinfill deposits when stream drainage from Beaver basin was integrated with that of Escalante Desert, west of Mineral Range. Gravel that mantles pediment is well preserved on Last Chance Bench in central part of quadrangle and locally overlies channels and lenses of reworked tuff of Ranch Canyon (Orct; 0.55 m.y.). Unit is extensively deformed by faults that were most recently active during late Quaternary. Faults form broad north-trending antiform of beyond margin (topographic wall) of caldera Last Chance Bench that has almost no structural relief in upper Pliocene to Volcaniclastic rocks—Dominantly volcanic-mudflow breccia and talus breccia lower Pleistocene deposits (QTsI). Faults that displace Quaternary deposits

Qrct TUFF OF RANCH CANYON (MIDDLE PLEISTOCENE)—Light-brown, poorly consolidated, rhyolitic air-fall tuff erupted from volcanoes in Mineral Mountains (Lipman and others, 1978), about 25 km northwest of Beaver. Primary and fluvially reworked ash-flow debris fill deeply excavated channels along Cunningham Wash; elsewhere unit consists of thin, dirty lenses of fluvially deposited silty to sandy pumiceous tuff. Reworked tuff was deposited after outlet from Beaver basin had been established through Mineral Range at

Minersville canyon, about 20 km west of Beaver, but before gravel of Last

Chance Bench (Qglc) had been deposited. Potassium-argon age 0.55±0.006

along margins of Beaver basin are considered tectonic and are most recent

manifestation of late Tertiary uplift of adjacent mountain ranges. Thickness

2 – 5 m; possibly thicker adjacent to Tushar Mountains and in buried alluvial

Qc COLLUVIAL DEPOSITS (HOLOCENE AND UPPER PLEISTOCENE) — Light-

formed from volcanic rocks of Tushar Mountains

BASALT OF RED KNOLL (MIDDLE PLEISTOCENE)

cone. Includes vent for lava flows (Qrk)

ene, olivine(?), and opaque minerals

cone. Includes vent for lava flows (Qck)

BASALT OF CRATER KNOLL (MIDDLE PLEISTOCENE)

finely granular matrix

- TERTIARY

TRIASSIC(?)

- PALEOZOIC

gray to reddish-brown silty sands to sandy gravels. Forms thin mantle of poorly

sorted debris on steep slopes of poorly consolidated basin-fill deposits (\mbox{QTs}) .

Also includes talus, rock-fall deposits, and slope-creep deposits. Generally

unstable and subject to further movement if disturbed. Thickness 0-2 m

slump (toreva) blocks of unbroken to highly fractured basalt of Cunningham

Hill (Qbc) and, in eastern part of quadrangle, large masses of landslide debris

cemented alluvium probably related to spring activity along one of several

major faults bordering Tushar Mountains. Mapped in sec. 7, T. 28 S., R.

scoriaceous surface and dense to vesicular interior. Phenocrysts of labradorite

and pyroxene make up 30-40 percent of rock and are set in glassy to very

Cinder cone—Red to dark-gray, basaltic cinders and ash forming a pyroclastic

Lava flow—Dark-gray to black, porphyritic, basaltic andesite having blocky,

scoriaceous surface and dense to vesicular interior. Phenocrysts of labradorite

and subordinate pyroxene make up 40-45 percent of rock and are set in

glassy to finely granular matrix containing microlites of plagioclase, pyrox-

to reddish-brown pebbly sand to sandy gravel on pediment cut across basin-

fill deposits (QTs). Soil has very well developed, reddish-brown argillic B

Cinder cone—Red to dark-gray, basaltic cinders and ash forming a pyroclastic

Oglc GRAVEL OF LAST CHANCE BENCH (MIDDLE PLEISTOCENE) — Light-brown

Landslide deposits (Holocene to middle Pleistocene?) - Large, cuspate rotational-

SPRING DEPOSITS (PLEISTOCENE?)—Isolated mass of calcium carbonate-

6 W., near Sunday Mine. Age and thickness poorly known

Ork Lava flows—Dark-gray to black, porphyritic, basaltic andesite having blocky,

m.y. (Izett, 1981) BASALT OF CUNNINGHAM HILL (LOWER PLEISTOCENE)—Dark-gray, scoriaceous to massive basalt. Lava flow filled ancestral valley of Cunningham Wash before through-flowing drainage was established out of Beaver basin. Location of vent is probably beneath younger basalt flows (Qck or Qrk) in northwestern part of quadrangle. Natural remanent magnetic direction of flow is weakly reversed, with strong normal overprint. Potassium-argon age 1.1 ± 0.3 m.y. (Best and others, 1980). Thickness 1-6 m; thicker where deposited in channels

SEDIMENTARY BASIN-FILL DEPOSITS (LOWER? PLEISTOCENE TO UPPER? MIOCENE)—Basin fill includes six informal units of poorly to moderately consolidated fluvial and lacustrine deposits that comprise two major sedimentary sequences (upper and lower). Upper sequence of basin fill consists of laterally gradational sequence of lacustrine (QTsI), piedmont (QTsp), and fanglomeratic (QTsf) sediments deposited in closed basin containing shallow but perennial lake, Lake Beaver (Machette, 1982a). Upper sequence of basinfill deposits is early (?) Pleistocene and late Pliocene in age, distinctly younger than basin-fill deposits of Sevier River Formation (Pliocene and Miocene) of High Plateaus of Utah, east of Tushar Mountains. Lower sequence of basinfill deposits is moderately oxidized (in surface exposure), calcareous and indurated. Its upper and lower members (Tsp and TsI) are fine grained and are separated by basinward-thinning(?), coarse-grained, conglomeratic member (Tsmf). Lower sequence of basin-fill deposits reflects sedimentation during more saline conditions, as evidenced by presence of gypsum and calcium carbonate, than does upper sequence. Lower sequence is Pliocene and late (?) Miocene and may be largely correlative with youngest part of Sevier River Formation. As mapped, poorly exposed undivided basin-fill deposits (QTs) are generally coarser-grained facies of upper sequence (QTsf), but may include sediments of lower sequence uplifted along western margin of Tushar Mountains. Deposition of basin fill occurred concurrently with structural development of Beaver basin from at least 9 m.y. ago (or earlier) until drainage from Beaver basin was integrated with that of Escalante Desert sometime between 1.1 and 0.55 m.y. ago, but probably about 0.75 m.y. ago (Machette,

1982a; Steven and others, 1982) Lacustrine facies (lower? Pleistocene and upper Pliocene) — Light- to mediumgreen silty clay and silt interbedded with well-bedded, light-gray to light-brown fine sand that grades laterally into pebbly sand. Ostracode and diatom collections from this unit suggest that water chemistry of Lake Beaver varied from fresh to slightly saline and was dominated by sodium and potassium cations relative to calcium and magnesium (Forester and Bradbury, 1981). This interpretation is supported by general lack of carbonate mineralization in lacustrine beds. Lacustrine facies is well exposed on north flank of Last Chance Bench and in area between Wildcat Creek and Indian Creek, below the Hogsback. Sedimentary structures in this unit indicate it was deposited in a shallow lake. A sequence of at least six distinct water-laid tephra (volcanic ash) beds are discontinuously exposed in this area. Second highest of these is 2.0-m.y.-old Huckleberry Ridge ash bed (formerly Pearlette type B ash, Izett and Wilcox, 1982). Huckleberry Ridge ash bed is widespread in lacustrine sediment from near Minersville Reservoir, 13 km southwest of Beaver, to northeast side of Cunningham Hill, in north-central part of quadrangle. Top of unit eroded. Thickness probably 200 – 250 m; may be considerably thicker and older in subsurface near Greenville

Piedmont facies (lower? Pleistocene to upper Pliocene) — Light-brown to lightreddish-brown (where oxidized) sequence of interbedded, subrounded fluvialchannel and deltaic(?) sand and subangular to subrounded pebble to cobble gravel derived from, and coarsening toward, adjacent mountain slopes. Contains zones of abundant manganese cementation. Best exposed along northern and southern sides of Last Chance Bench near U.S. Highway 91. Minimum exposed thickness 100 m; base covered

Fanglomerate facies (lower? Pleistocene to upper Pliocene)—Light-reddishbrown, uniformly coarse-grained, sandy, subangular pebble to cobble gravel. Unit exposed mainly along west front of Tushar Mountains. Table Grounds. the high-level depositional surface between North Creek and Beaver River, 5 km northeast of Beaver, is youngest preserved part of unit. Soil on Table Grounds has an eroded argillic B horizon and a 1.5-m-thick stage IV (laminated) K horizon. Machette (1982a) has estimated that this surface was probably formed about 0.75 m.y. ago. Base covered; minimum exposed thickness 100 m. Unit at least several hundred meters or more thick along eastern margin of Beaver basin, where sedimentation and tectonism oc-

Upper piedmont member (Pliocene) - Light-brown and light-reddish-brown,

moderately oxidized gypsiferous sand, sandy conglomerate, and white calcareous marl. Moderately oxidized and indurated throughout; contains sandstone lenses cemented by calcium carbonate and discrete calcium carbonate nodules. In subsurface, piedmont facies may grade southward into playa facies, eastward and westward into fanglomeratic facies. About 100 – 150 m is exposed beneath basalt of Cunningham Hill (Qbc) Conglomerate of Maple Flats (lower? Pliocene) — Light-brown to light-reddish-

brown pebbly sand to boulder conglomerate. Boulders of Tertiary granite (Tigr) and Paleozoic rock (Pzc) as large as 2 m, derived from Mineral Mountains, commonly mantle eroded top of deposit. Unit deposited in response to major uplift and structural development of Beaver basin (Machette, 1982a). Conglomerate exposed mainly in uplifted horst of Maple Flats in northwestern part of quadrangle. Thickness probably about 250 m; to south it may thin to feather edge and become finer grained in subsurface

Lower piedmont member (lower? Pliocene to upper? Miocene) — Oxidized, lightbrown and reddish-brown, slightly gypsiferous silty clay to pebbly sand. Unit exposed only below conglomerate of Maple Flats (Tsmf). Near Minersville Reservoir, 9 km southwest of quadrangle along Beaver River, same or slightly older deposits consist of poorly sorted stream-channel-filling conglomerates containing abundant clasts of rhyolitic pumice; these rocks are overlain by basalt dated at 7.6 m.y. by Best and others (1980). Pumice probably produced by local rhyolitic eruptions that are also dated at 7.6 m.y. (S. H. Evans, University of Utah, written commun. to T. A. Steven, 1981), suggesting that lower piedmont member may extend into late Miocene. Subsurface data suggest that unexposed portions of member are coarse grained and perhaps as

much as 1000 m thick. Base is everywhere covered; exposed thickness 75 m

Rhyolite tuff-Soft, white, zeolitically altered ash-flow tuff interlayered with rhyolite (Trg). Tuff filled local valley and formed apron on northwest flank

sisting mostly of finely granular to micrograghic or spherulitic aggregate of orthoclase, quartz, and some plagioclase. Small phenocrysts of quartz and feldspar present locally. Altered phases contain sparse disseminated pyrite. Forms dikes that cut syenite (Tis) and granite (Tigr). Possibly is phase of

Joe Lott Tuff Member-Light-gray to light-brown, crystal-poor, slightly to moderately welded, porous to dense alkali rhyolitic ash-flow tuff. Contains about 1.5 percent phenocrysts of quartz, sanidine, and plagioclase, traces of biotite and, locally, as much as 5 percent small, dark xenoliths of aphanitic volcanic rock. Comprises most of outflow facies of Mount Belknap Volcanics. Stratigraphic position relative to other isotopically dated units indicates an age of about 19 m.y. Thickness about 10 m, but more than 500 m close to source in the Tushar Mountains, east of quadrangle

Intrusive rock—Small, light-gray, porphyritic rhyolite stock containing prominent flow-alined alkali feldspars in granular mosaic of alkali feldspar and quartz. Exposed along North Fork of North Creek in sec. 10, T. 28 S., R. 6 W. Mount Baldy Rhyolite Member—Light-gray to yellowish-brown (where altered), crystal-poor, rhyolite lava flows, domes, and feeder dikes, consisting largely of fine-grained granular mosaic of quartz, alkali feldspar, and minor plagioclase, biotite, and hematite. Contorted flow layers common. Erupted largely within Mount Belknap caldera (Cunningham and Steven, 1979) but locally extends

derived from erosion of nearby lava flows of Mount Baldy Rhyolite Member (Tmb). Includes landslide debris and fluviatile sand and gravel Middle tuff member—Light-gray to light-brown, crystal-poor, slightly to moderately welded ash-flow tuff. Exposed near middle of caldera fill within Mount Belknap caldera. Similar to Joe Lott Tuff Member (Tmj) Blue Lake Rhyolite Member—White to light-brown, crystal-poor rhyolite lava

caldera. Flows similar to those in Mount Baldy Rhyolite Member (Tmb) Tigt GRANITE (MIOCENE?)—White to gray, coarse-grained, porphyritic to Mount Belknap Volcanics (Miocene)

vesicular to dense, locally amygdaloidal mafic lava flows, containing plagioclase (rarely as phenocrysts), olivine (commonly altered), pyroxene, and irontitanium oxides. Generally contains three or more weight percent K₂O. Deposited against rocks of formation of Lousy Jim (Tlj) of Sigmund (1979) near Black Ridge in southeastern part of quadrangle. Potassium-argon ages are 21.7 ± 0.8 m.y., 22.1 ± 0.8 m.y. (H. H. Mehnert, written commun., 1980), and 23.2±0.2 m.y. (Best and others, 1980). Thickness about 150 m FORMATION OF LOUSY JIM (SIGMUND, 1979) (MIOCENE)—Pinkish-gray and

or nonwelded, rhyolitic ash-flow tuff consisting of glass shards, pumice

andesitic composition. Aphanitic to conspicuously porphyritic, containing

oxides, plus about 2-10 percent volcanic xenoliths, in a devitrified matrix of shards, dust, and pumice. Tuff lapped onto flanks of active volcano of Mount

dust, and pumice. Tuff lapped onto flanks of active volcano of Mount Dutton Formation (Td). Named for outcrops on Black Mountain in southeastern part

stocks in northeastern part of quadrangle. First and smaller stock is along Pine Creek and consists of highly porphyritic plagioclase-biotite-hornblende quartz latite. Second stock intruded flows and breccias of Bullion Canyon Volcanics (Tb) along Indian Creek; consists of equigranular, fine- to medium-grained quartz monzonite containing about equal proportions of plagioclase and orthoclase, as much as 20 percent quartz, and lesser quantities of augite, horn-

Flows and breccias (Miocene and Oligocene)—Heterogeneous assemblage of light- to dark-gray and brown, porphyritic rhyodacite and quartz latite lava flows, flow breccia and volcanic-mudflow breccia, characterized by abundant phenocrysts of plagioclase, hornblende, biotite, and clinopyroxene. Several dark-brown, aphanitic lava flows of intermediate composition, containing phenocrysts of clinopyroxene and plagioclase, included in this unit near southeast margin of quadrangle. Intensely propylitized near intrusive rocks, such as in Fortuna Canyon in northern part of quadrangle. Thickness in hun-

flows and local ash-flow tuffs. Mapped where underlain by Delano Peak Tuff Member (Tbd) along Beaver River near Ponderosa Park, in southeastern part Delano Peak Tuff Member (Miocene)-Reddish-brown, densely welded,

phyritic to hypidiomorphic-granular rock with predominant orthoclase and plagioclase, and lesser amounts of hornblende, clinopyroxene, and sparse biotite. Sphene and iron-titanium oxide grains are common accessory minerals Feldspars vary from predominantly orthoclase to subequal amounts of orthoclase and plagioclase. Sparse, highly resorbed grains of quartz present locally. Found only in northwestern part of quadrangle, where it cuts gabbro porphyry (Tig) with which it is closely associated. May be related to 22- to 27-m.y.-old monzonite intrusions near Sulphurdale, about 30 km north of

Tb and Tbi near northeast corner of quadrangle FAULT—Dashed where approximately located; dotted where concealed. Bar and

rotation of blocks of basalt of Cunningham Hill (Qbc) where they overlie fine-

LANDSLIDE SCARP—Topographic scarps produced by slumping and gravitational

QUARTZ VEIN-Inclination and direction of dip shown where known. Mapped in secs. 19, 20, 30, T. 27 S., R. 6 W., and secs. 5, 6, 7, T. 28 S., R. 6 W. STRIKE AND DIP OF LAVA FLOWS AND SEDIMENTARY BEDS

Anderson, J. J., Lanigan, J. C., Cunningham, C. B., and Naesar, C. W., 1981, Geologic map

of the Beaver SE quadrangle, Beaver County, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1274, scale 1:24,000. Best, M. G., McKee, E. H., and Damon, P. E., 1980, Space-time-composition patterns of late

Transactions of the American Geophysical Union, 20th Annual Meeting, Washington, D.C., 1939, v. 20, pt. 3, Section on Volcanology, p. 438-452. Callaghan, Eugene, and Parker, R. L., 1961, Geologic map of part of the Beaver quadrangle, Utah: U.S. Geological Survey Mineral Investigations Field Studies Map MF-202, scale

associated rocks, Marysvale volcanic field, west-central Utah: U.S. Geological Survey Bulletin __1980, Geologic map of the Beaver NE quadrangle, west-central Utah: U.S. Geological

Cunningham, C. G., Steven, T. A., and Naeser, C. W., 1982, Multiple episodes of igneous activity, mineralization, and alteration in the western Tushar Mountains: U.S. Geological Survey Open-File Report 82-479, 20 p. Cunningham, C. G., Steven, T. A., Rowley, P. D., Glassgold, L. B., and Anderson, J. J.,

1983. Geologic map of the Tushar Mountains and adjoining areas, Marysvale volcanic field, Utah: U.S. Geological Survey Miscellaneous Investigations Series Map I-1430-A, scale __1984, Map of argillic and advanced argillic alteration and principal hydrothermal quartz and alunite veins in the Tushar Mountains and adjoining areas, Marysvale volcanic field,

Utah: U.S. Geological Survey Miscellaneous Investigations Series Map I-1430-B, scale 1:50.000. Evans, S. H., Jr., and Steven, T. A., 1982, Rhvolites of the Gillies Hill-Wood Tick area. Reaver County, Utah: Geological Society of America Bulletin, v. 93, no. 11, p. 1131-1141. Fleck, R. J., Anderson, J. J., and Rowley, P. D., 1975, Chronology of mid-Tertiary volcanism in High Plateaus region of Utah, in Anderson, J. J., Rowley, P. D., Fleck, R. J., and Nairn,

A. E. M., Cenozoic geology of southwestern High Plateaus of Utah: Geological Society of America Special Paper 160, p. 53-62. Forester, R. M., and Bradbury, J. P., 1981, The paleoenvironmental implications of the ostracodes and diatoms from selected samples in Pliocene and Pleistocene lacustrine sediments in the Beaver basin, Utah: U.S. Geological Survey Open-File Report 81-390, 41 p.

Gile, L. H., Peterson, F. F., and Grossman, R. B., 1965, The K-horizon—A master soil horizon of carbonate accumulation: Soil Science, v. 99, no. 2, p. 74-82. ____1966, Morphology and genetic sequences of carbonate accumulation in desert soils: Soil Science, v. 101, no. 5, p. 347-360. Izett, G. A., 1981, Volcanic ash beds—Recorders of upper Cenozoic silicic pyroclastic volcanism

Geological Survey Miscellaneous Investigation Series Map I-1325, scale 1:4,000,000.

in the Western United States: Journal of Geophysical Research, v. 86, no. B11, p. 10200-10222. Izett, G. A., and Wilcox, R. E., 1982, Map showing localities and inferred distributions of the Huckleberry Ridge, Mesa Falls, and Lava Creek ash beds (Pearlette family ash beds) of Pliocene and Pleistocene age in the western United States and southern Canada: U.S.

Lipman, P. W., Rowley, P. D., Mehnert, H. H., Evans, S. H., Jr., Nash, W. P., and Brown, F. H., 1978, Pleistocene rhyolite of the Mineral Mountains, Utah—Geothermal and archeological significance: U.S. Geological Survey Journal of Research, v. 6, no. 1, p. Machette, M. N., 1982a, Guidebook to the late Cenozoic geology of the Beaver basin, southcentral Utah: U.S. Geological Survey Open-File Report 82-850, 42 p.

_____1982b, Geologic map of the southwest quarter of the Beaver quadrangle, Beaver County, Utah: U.S. Geological Survey Miscellaneous Investigations Series Map I-1444, scale 1:24.000. Machette, M. N., and Steven, T. A., 1982, Geologic map of the northwest quarter of the Beaver quadrangle, Beaver County, Utah: U.S. Geological Survey Miscellaneous Investigations

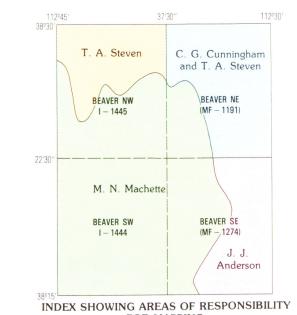
Series Map I-1445, scale 1:24,000. Parsons, W. H., ed., 1965, Structures and origin of volcanic rocks, Montana-Wyoming-Idaho— National Science Foundation Summer Conference, 1965, Guidebook: Detroit, Mich., Wayne State University, 58 p.

_____1969, Criteria for the recognition of volcanic breccias—Review, in Larsen, L. H., ed., Igneous and metamorphic geology (the Poldervaart volume): Geological Society of America Memoir 115, p. 263-304. Sigmund, J. M., 1979, Geology of a Miocene rhyodacite flow, southern Tushar Mountains [Utah]:

Kent, Ohio, Kent State University, unpublished M.S. thesis, 35 p. Smedes, H. W., and Prostka, H. J., 1973, Stratigraphic framework of the Absaroka Volcanic Supergroup in the Yellowstone National Park region: U.S. Geological Survey Professional Paper 729-C, 33 p.

Steven, T. A., Cunningham, C. G., and Anderson, J. J., 1979, Uranium potential of the Big John Caldera, Beaver County, Utah: U.S. Geological Survey Open-File Report 79-527, Steven, T. A., Cunningham, C. G., and Machette, M. N., 1982, Integrated uranium systems in the Marysvale volcanic field, west-central Utah, in Goodell, P. C., and Waters, A. C.,

eds., Uranium in volcanic and volcaniclastic rocks: American Association of Petroleum Geologists Studies in Geology, no. 13, p. 111-122. Steven, T. A., Cunningham, C. G., Naeser, C. W., and Mehnert, H. H., 1979, Revised stratigraphy and radiometric ages of volcanic rocks and mineral deposits in the Marysvale area, west-central Utah: U.S. Geological Survey Bulletin 1469, 40 p.



GEOLOGIC MAP OF THE BEAVER QUADRANGLE, BEAVER AND PIUTE COUNTIES, UTAH

to reddish-brown, poorly to moderately sorted silt, sand, and gravel. Intertongues with or overlies old terrace alluvium (Qto). Soil has well-developed,

2-10 m thick

INTERIOR-GEOLOGICAL SURVEY, RESTON, VA. - 1984-G8313

CONTOUR INTERVAL 80 FEET

Geology mapped in 1978 — 1982

CORRELATION OF MAP UNITS

Qck Qckc

UNCONFORMITY

MOUNT BELKNAP VOLCANICS—

-BULLION CANYON-

VOLCANICS

DESCRIPTION OF MAP UNITS

STREAM DEPOSITS (HOLOCENE AND PLEISTOCENE) - Moderately to well-

and thin strath terraces. Soil data given by Machette (1982a, table 1)

Undivided stream and sheetwash alluvium (Holocene and upper Pleistocene) —

Undivided flood-plain alluvium (Holocene)—Light-brown to light-gray, medium

to coarse sand and pebbly to bouldery gravel. Forms broad, slightly dissected

surface along Beaver River and North Creek, and toward Tushar Mountains

fills narrow channels cut in older alluvial deposits. Numerous seeps and springs

indicate that ground-water level is near surface of unit along Beaver River.

Also includes thick beds of silt and fine sand containing abundant organic matter

and calcium carbonate that fill deeply excavated channels along lower parts

of Wildcat and Indian Creeks and their tributaries. These beds were deposited

medium to coarse sand and pebbly to bouldery gravel. Forms broad, slightly

elevated and coalesced former flood plains of Beaver River and North Creek

near Beaver, and downstream forms terrace 5 – 6 m above modern floodplain of Beaver River, near Adamsville (3 km west of quadrangle). Near Mander-

field, terrace is 3 – 5 m above Indian Creek. Soil has weak argillic B horizon

and Cca horizon, but near Beaver is generally noncalcareous or only weakly

calcareous (stage I of Gile and others, 1966) because of high water table.

Mainly glacial outwash and associated alluvium of most recent major glacia-

tion, the Pinedale, which may have ended about 12,000 to 15,000 yrs ago

in this region. Major source of high-quality sand and gravel. Thickness 2-4

medium to coarse sand and gravel. Forms terrace surface 12 – 13 m above

Beaver River near Greenville, and 10-13 m above Indian Creek near

Manderfield. Soil has moderately developed argillic B horizon and stage II

to stage III Cca horizon (stages defined by Gile and others, 1966). Mainly

glacial outwash and associated alluvium of Bull Lake Glaciation, here con-

sidered to have ended about 140,000 yrs ago. Minor source of moderate-

Old terrace alluvium (middle Pleistocene) - Light-brown to reddish-brown sand

and gravel. Forms terrace surface 16 – 18 m above Beaver River near Green-

ville. Terrace is 60 – 65 m above Chokecherry Hollow, west of Wildcat Fields,

and about 25 m above Indian Creek, west of quadrangle. Soil has well-

developed, thick argillic B horizon (locally eroded) and stage III Cca horizon.

Considered to be glacial outwash and associated alluvium of a major glacia-

tion preceding the Bull Lake, about 250,000 yrs ago. Moderately deformed

by normal faults, especially west of Greenville. Thick deposits below soil are

major source of high-quality sand and gravel. Thickness generally 2 – 10 m

brown sand and gravel, poorly exposed along fault-controlled(?), southwest-

trending stream valley between Wildcat and Indian Creeks. Topographically

higher than old terrace alluvium (Qto) and lower than gravel of Last Chance

Bench (Qglc). Deposition of unit may be related to faulting rather than to

climatic event. Deposit is estimated to be about 350,000 yrs old, based on

isotopically determined ages from other alluvial units (see Machette, 1982a).

Projected height above Indian Creek about 35 m. Thickness generally 2 – 5 m

mantle of alluvium on piedmont slopes and thick accumulations of locally de-

rived alluvial-fan deposits near mountain fronts. Generally more poorly sorted,

more angular, and more variable in lithologic composition than terrace and

flood-plain alluvium. Units are widespread along eastern flank of Mineral Mountains west of quadrangle, along northern flank of Black Mountains

southwest of quadrangle, and along western margin of Tushar Mountains in

eastern part of quadrangle. Soil data given by Machette (1982a, table 1) Young piedmont-slope and alluvial-fan deposits (upper Pleistocene)—Light-

brown to light-reddish-brown, poorly to moderately sorted silt, sand, and

gravel. Intertongues with or overlies young terrace alluvium (Qty). Soil has

weak argillic B horizon and stage I to weak stage II Cca horizon. Surface smooth

and relatively undissected. Thickness generally 2-4 m; fan deposits 2-10

brown to light-reddish-brown, poorly to moderately sorted silt, sand, and

gravel. Intertongues with or overlies middle terrace alluvium (Qtm). Soil has

moderately developed argillic B horizon and stage II to stage III Cca horizon.

Surface irregular and moderately dissected. Thickness 2 – 4 m; fan deposits

thick argillic B horizon and stage III Cca horizon. Surface highly dissected.

Young and middle piedmont alluvium (Qpy and Qpm) deposited in chan-

Pleistocene) — Consists largely of middle (Qpm) and old (Qpo) deposits. Un-

Undivided piedmont-slope and alluvial-fan deposits (upper to middle

Opo Old piedmont-slope and alluvial-fan deposits (middle Pleistocene)—Light-brown

nels cut into old piedmont alluvium. Thickness 2-4 m

divided because poorly exposed. Thickness 2-4 m

Middle piedmont-slope and alluvial-fan deposits '(upper Pleistocene) - Light-

PIEDMONT-SLOPE AND ALLUVIAL-FAN DEPOSITS (PLEISTOCENE)—Thin

Gravel of ancestral Indian Creek (middle Pleistocene) - Light-brown to reddish-

Middle terrace alluvium (upper Pleistocene) — Light-gray to light-reddish-brown,

m; more than 4 m along Beaver River and North Creek

quality sand and gravel. Generally 2-4 m thick

Young terrace alluvium (upper Pleistocene) — Light-brown to light-reddish-brown,

in a marsh environment. Thickness at least 5 m, base covered

arroyos. Thickness probably less than 4 m

rounded, well-sorted sand and gravel that fills channels and forms flood plains

Light-brown and light-gray silt, sand, and gravel. Consists of locally derived

UNCONFORMITY

-BASIN-FILL DEPOSITS-